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|  | **Unit 1: Biochemistry** | | | | | | | |
| Name: | | Start: | | | 09/20/16 |  |  |  |
|  | | Test 2 Date: | | | 10/17/16 |  |  |  |
| Period: (Honors) | | Teacher: Ms. J | | | |  |  |  |
|  | |  |  |  |  |  |  |  |
| **Biochemistry Part II** | | Submitted | Resubmit | Correct | Evidence of Learning | Page | Date | Sign-Off |
| **Objective 4:** Explain how DNA and RNA code for proteins and determine traits. | |  |  |  | **POGIL: DNA Replication** |  |  |  |
|  |  |  |  |  |
|  |  |  | **Catalyst 1: TBD** |  |  |
|  |  |  | **Notes: Replication** |  |  |
|  |  |  | **HW: DNA Replication Practice** |  |  |
|  |  |  | **Catalyst 2: Replication Enzymes** |  |  |
|  |  |  | **Notes: Transcription & Translation** |  |  |
|  |  |  | **POGIL: Transcription & Translation** |  |  |
|  |  |  | **Class Activity: Protein Synthesis** |  |  |
|  |  |  | **Worksheet: Protein Synthesis** |  |
|  |  |  | Creative Project: Central Dogma Explanation |  |  |
|  |  |  | Writing: Working in a Protein Factory |  |
|  |  |  | **Quiz: Objective 4** |  |  |

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|  | | Second Position | | | | | | | |  | |
| U | | C | | A | | G | |
| First Position | U | UUU | Phenylalanine (phe) | UCU | Serine  (ser) | UAU | Tyrosine  (tyr) | UGU | Cysteine  (cys) | U | Third Position | |
| UUC | UCC | UAC | UGC | C |
| UUA | Leucine  (leu) | UCA | UAA | *STOP* | UGA | *STOP* | A |
| UUG | UCG | UAG | UGG | Tryptophan (trp) | G |
| C | CUU | Leucine  (leu) | CCU | Proline  (pro) | CAU | Histidine  (his) | CGU | Arginine  (arg) | U |
| CUC | CCC | CAC | CGC | C |
| CUA | CCA | CAA | Glutamine (gln) | CGA | A |
| CUG | CCG | CAG | CGG | G |
| A | AUU | Isoleucine (ile) | ACU | Threonine (thr) | AAU | Asparagine (asn) | AGU | Serine  (ser) | U |
| AUC | ACC | AAC | AGC | C |
| AUA | ACA | AAA | Lysine  (lys) | AGA | Arginine  (arg) | A |
| AUG | Methionine (met) *START* | ACG | AAG | AGG | G |
| G | GUU | Valine  (val) | GCU | Alanine  (ala) | GAU | Aspartic acid (asp) | GGU | Glycine  (gly) | U |
| GUC | GCC | GAC | GGC | C |
| GUA | GCA | GAA | Glutamic acid (glu) | GGA | A |
| GUG | GCG | GAG | GGG | G |

**Unit 1: Biochemistry**

Start Date: 09/20/2016 Test 2 Date: 10/17/2016

**Objective 3:** Explain the double-stranded, complementary nature of DNA as related to its function in the cell.

*Essential Question:* What is the structure of DNA?

*Essential Question:* What is the structure of RNA?

*Essential Question:* How is DNA replicated?

*“I Can” Statements:*

* Identify the double-helix structure of DNA, with sides composed of alternating phosphate-sugar groups and “rungs” composed of complementary nitrogenous base pairs joined by weak hydrogen bonds
* Match DNA base-pair nucleotides (A-T, G-C) appropriately
* Develop a cause-and-effect model relating the structure of DNA to the functions of replication, transcription, and translation (protein synthesis)
* Compare/contrast DNA and RNA
* Explain that the sequence of nucleotides in DNA can code for proteins, but also encodes tRNA and rRNA and some stretches of DNA that appear to have no function.

**Objective 4: Explain how DNA and RNA code for proteins and determine traits.**

***Essential Question:* What are the roles of mRNA, tRNA, and rRNA in the protein synthesis process?**

***“I Can” Statements:***

* **Interpret a codon chart to predict the amino acids coded for by a nucleotide sequence.**
* **Identify the roles of the three types of RNA (tRNA, mRNA, rRNA)**
* **Explain the connection between nucleotide sequence and the resulting protein (Central Dogma: DNA 🡪 mRNA 🡪 protein)**
* **Explain the process of protein synthesis**
  + **Transcription that produces an RNA copy of DNA, which is further modified into the three types of RNA**
  + **mRNA traveling to the ribosome (rRNA)**
  + **Translation – tRNA supplies appropriate amino acids**
  + **Amino acids are linked by peptide bonds to form polypeptides. Polypeptide chains from protein molecules. Proteins can be structural (forming a part of the cell materials) or functional (hormones, enzymes, or chemical involved in cell chemistry).**
* **Explain how an amino acid sequence forms a protein that leads to a particular function and phenotype (trait) in an organism.**
* **Explain how cells can responds to their environments by producing different types and amounts of proteins by changing the expression of genes.**

**Objective 5:** Explain how mutations in DNA that result from interactions with the environment (i.e. radiation and chemicals) or new combinations in existing genes lead to changes in function and phenotype.

*Essential Question:* What happens when mutations occur in DNA?

*“I Can” Statements:*

* Model how changes in nucleotide sequence (mutations) can alter the resulting protein
* Infer the advantages (injury repair) an disadvantages (cancer) of the overproduction, under production, or production of proteins at incorrect times
* Develop a cause-and-effect model in order to describe how mutations occur: changing amino acid sequence, protein function, phenotype
* Explain that changes in the DNA sequence (mutations) can be deletions, additions, or substitutions

**CATALYST 1**

**CATALYST 2**

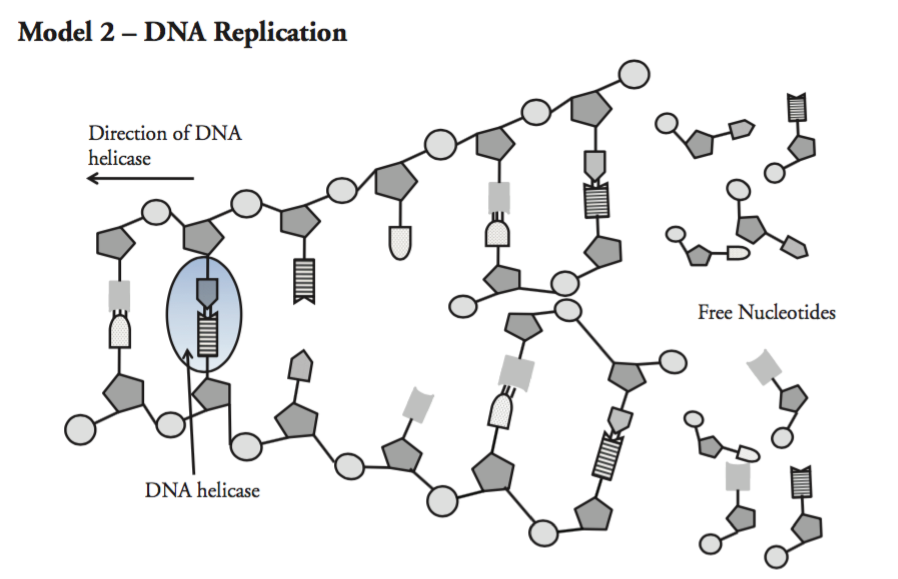
**DNA Structure and Replication**

How is genetic information stored and copied?



Deoxyribonucleic acid or **DNA** is the molecule of heredity. It contains the genetic blueprint for life. For organisms to grow and repair damaged cells, each cell must be capable of accurately copying itself. So how does the structure of DNA allow it to copy itself so accurately?

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1. Examine Model 2. Number the steps below in order to describe the replication of DNA in a cell. \_\_\_\_\_\_ Hydrogen bonds between nucleotides form. \_\_\_\_\_\_ Hydrogen bonds between nucleotides break. \_\_\_\_\_\_ Strands of DNA separate.  \_\_\_\_\_\_ Free nucleotides are attracted to exposed bases on the loose strands of DNA.
2. Locate the DNA helicase on Model 2.
   1. *What type of biological molecule is DNA helicase?*
   2. *What is the role of DNA helicase in the replication of DNA?*
3. What rule is used to join the free nucleotides to the exposed bases of the DNA?
4. This type of replication is called **semi-conservative replication**. Considering the meaning of these words (semi—half; conserve—to keep), explain why DNA replication is called semi-conservative.
5. DNA molecules can be tens of thousands of base pairs in length. Mistakes in DNA replication lead to mutations, which may or may not be harmful to an organism. How does semi-conservative replication help prevent mutations during DNA replication?

6. The proportions of the bases are consistent within a species; however they do vary between species. Using the base-pair rules, complete the following table to show the percentage of each type of base in the different organisms.

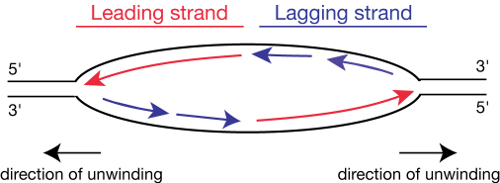
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Organism** | **Percentage of each type of base** | | | |
| **Adenine** | **Guanine** | **Cytosine** | **Thymine** |
| Human | 31 |  | 19 |  |
| Cow | 28 | 22 |  |  |
| Salmon |  |  | 21 | 29 |
| Wheat | 27 |  |  |  |
| Yeast | 31 | 19 |  |  |

7. In the space below, draw your understanding of DNA replication. What does the original strand look like compared to the newly created strand?

Biology (Honors)

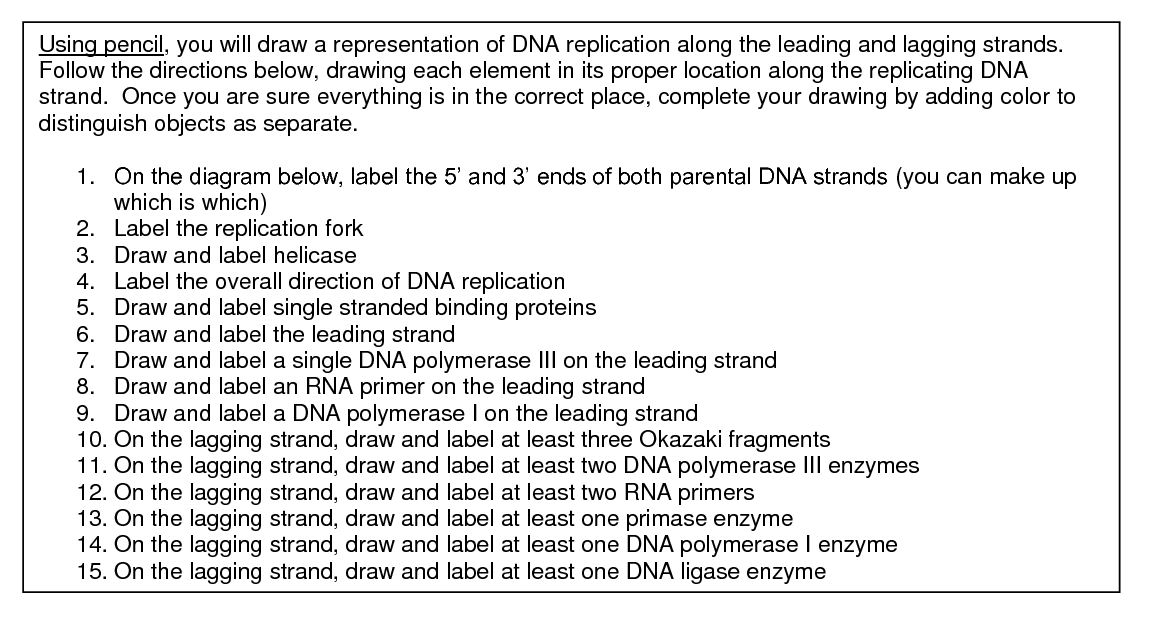
Replication Notes

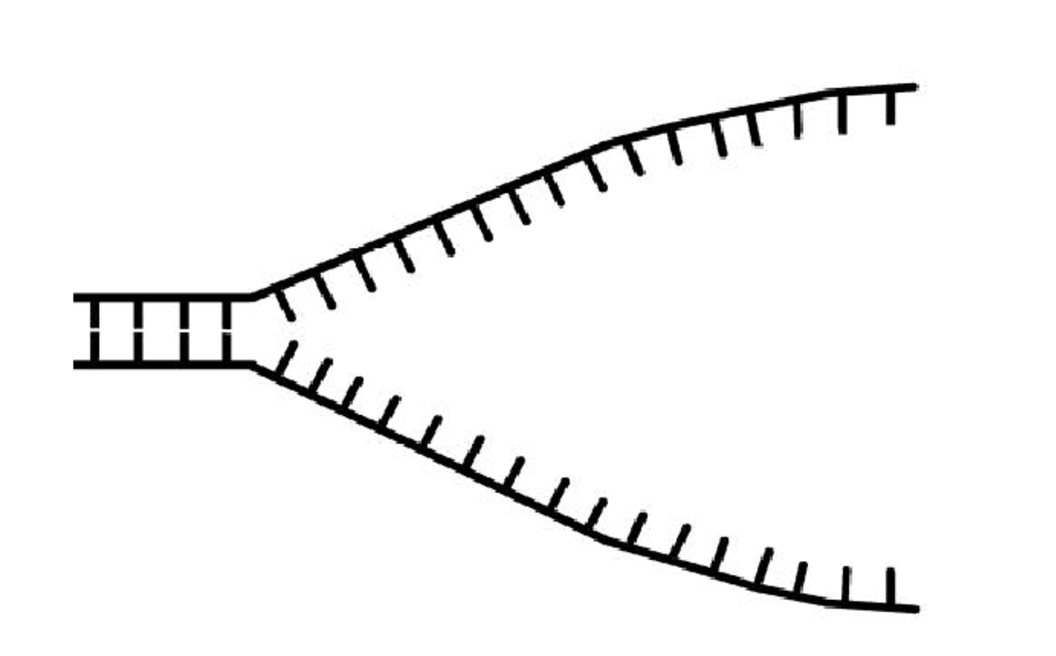
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Biology (Honors)

HW: DNA Replication Practice





Biology (Honors)

Notes: Transcription & Translation

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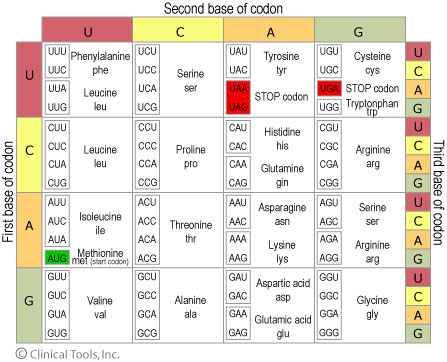
Biology (Honors) Name: *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

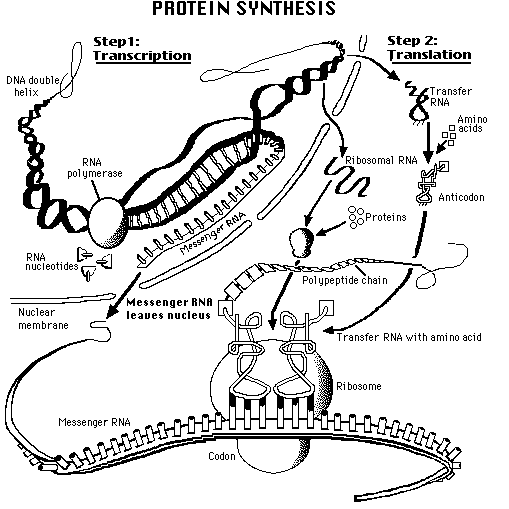
Worksheet: Protein Synthesis (Chart) Period: \_\_\_ Date: \_\_\_/\_\_\_/\_\_\_

**Objective 4:** Explain how DNA and RNA code for proteins and determine traits.

**Part I: Codon Identification**

*Use the mRNA codon chart to indicate what amino acid the following codons code for.*

1. CAG: *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
2. AGU: *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
3. GUU: *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
4. GUA: *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
5. UAA: *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
6. CAC: *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
7. UUU: *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
8. AUG: *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
9. UGG: *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
10. UGA: *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

*Write any and all codons that code for the following amino acids.*

1. Methionine: *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
2. Threonine: *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
3. Leucine: *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
4. Isoleucine: *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
5. Aspartic Acid: *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

***Part II: Transcription***

*Write in the mRNA codons that match the following DNA strand.*

1. TAC CCG TTC GTA TAG ATG GGA GGG AAA TTT CCC CGT GCA CCT ACT

*\_\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_*

***Part III: Translation***

*Write in the correct amino acids that pair with the following mRNA codons:*

1. AUG UUG CCG GUA AUC CUG UUU GGU UAA

*\_\_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_\_*

***Part IV: DNA Synthesis***

*Below is a given strand of DNA. First, Divide the strand into codons and record these in the chart below. Second, Transcribe the DNA into mRNA and write this in column 2. Third, Determine the tRNA anticodons from the mRNA and write this in column 3. Finally, record the sequence of amino acids in this protein in column 4. Remember that the chart refers to mRNA codons, not tRNA anticodons! The first row has been done for you.*

3’ TAC TTC GCG ACG ATA CGC CAG GCT TGA ACG CCT CGA GAT ATG AAA CCA CGT GGG TGC ACC AGC CGA TTC GCC TTT CCG CTT AGC CTC ATC 5’

|  |  |  |  |
| --- | --- | --- | --- |
| DNA Strand | MRNA Codon | **TRNA Anti-codon** | Amino Acid |
| *TAC* | *AUG* | *UAC* | *Methionine* |
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**How does a cell interpret DNA?**

**Procedure**

1. A certain gene has the following sequence of nucleotides:

**GAC AAG TCC ACA ATC**

Write this sequence in the space below direction #4.

1. From left to right, write the sequence of the mRNA molecule transcribed from this gene.
2. Using your Genetic Code Chart, read the mRNA codons from left to right and write the amino acid sequence of the protein.
3. Repeat step 3 reading the codons from right to left.

**Analyze and Conclude**

1. Why did steps 3 and 4 produce different proteins?
2. Do cells usually decode nucleotides in one direction only or in either direction?

Biology (Honors) Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Creative Project: Central Dogma Explanation Period: \_\_\_\_ Date: \_\_\_/\_\_\_/\_\_\_

**Objective 4:** Explain how DNA and RNA code for proteins and determine traits.

**Procedure:**

You know that the central dogma of molecular biology explains how DNA is used to ultimately create proteins. It is now your task to create an explanation for each step of the diagram shown below. A list of terms you **must use** in your writing is also included below. Each word, used correctly, is worth 2 points.

**DNA**

**mRNA**

**Proteins**

**Transcription**

**Translation**

**Replication**

**Vocabulary Terms:**

* Adenine
* Amino Acid
* Anticodon
* Chargaff’s rules
* Codon
* Cytoplasm
* Cytosine
* DNA
* DNA Ligase
* DNA Polymerase
* Double-stranded
* Enzyme
* Exon
* Guanine
* Helicase
* Hydrogen Bond
* Intron
* Mutation
* mRNA
* Nitrogen bases
* Nucleotide
* Nucleus
* Peptide Bond
* Polypeptide
* Protein
* Replication
* Ribosome
* RNA Polymerase
* rRNA
* Phosphate
* Semiconservative
* Single-stranded
* Thymine
* Topoisomerase
* Transcription
* Transcription factors
* Translation
* tRNA
* Helix
* Uracil

Teacher Comments:

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Biology (Honors)

Writing: Working in a Protein Factory

**Objective 4:** Explain how DNA and RNA code for proteins and determine traits.

**Introduction:**

Cheeseburgers, steaks, tuna! Sounds yummy right? Not only are these foods good to eat, they provide us with a much needed organic macromolecule – proteins. Proteins are essential to life – we break proteins down into the amino acids that are used by our bodies to make muscles, hair, and antibodies. Most of our physical traits such as eye color and skin tone are due to the proteins are bodies make from the amino acids we get from eating and breaking down proteins. So how do we make these important molecules? Each of our cells carries instruction within our DNA to make proteins. Proteins are coded for by our DNA in the nucleus and are assembled in the cytoplasm at the ribosomes. The cells’ machinery must work together to make the proteins – if one part fails, the protein is not made!

**Procedure:**

You are to create a manual for new employees of a protein making factory – similar to a manual that might be written to explain the jobs of each person in an assembly line used to make bikes or cars or to make food in a restaurant. The idea that the cell is a system just like an assembly line at a factory or restaurant helps students to develop an understanding that each job is important – just think what would happen in a restaurant if the dishwasher didn’t do their job!

Your company, Manuals R Us, has been hired to develop a manual/employee packet (written, digital or video) for training new employees of the Protein Factory. Your job is to list each job and then a job description including the role of the worker and any safety concerns with the job. Jobs descriptions for the following MUST be included: Nucleus, ribosomes, DNA, mRNA, tRNA, nucleotides, initiation factors, termination factors and enzymes such as: helicase, RNA polymerase, aminoacyl tRNA synthetases. Research to determine if there are other key jobs to include in your manual.

Your manual/employee packet needs to answer the following questions (employees will have questions once they read their manual!) – this could be done as an FAQ page.

1. Who is in charge of the factory?
2. What happens if I show up 5 minutes late for work?
3. What is the hierarchy of employees – who is at the top and the order in which the rest follows. Who is at the end of the line?
4. Do we all get paid the same? Why or why not?
5. What job(s) get paid the most? Why?
6. Who will I be working with the most closely? (answer from the perspective of the ORDER of protein synthesis). Why must I work with them?
7. What happens if I am sick one day – can someone else fill in for me?
8. Why do I not have any vacation days?
9. Will my job change? Will I be able to move up the ladder in the hierarchy of making proteins?
10. What happens if I do my job incorrectly? Will I be fired or destroyed? What is the effect on the other workers? What is the effect on the final product?

You may work individually or with a partner to complete this writing assignment.

**Scoring Rubric**

|  |  |  |
| --- | --- | --- |
| *Requirement* | *Points scored* | *Points possible* |
| Title |  | 2 |
| Nucleus |  | 4 |
| Ribosome |  | 4 |
| DNA |  | 4 |
| mRNA |  | 4 |
| tRNA |  | 4 |
| nucleotides |  | 4 |
| Enzyme(s) |  | 10 |
| Amino acids |  | 4 |
| Other job(s) |  | 16 |
| Creativity |  | 4 |
| Mechanics (grammar/spelling) |  | 10 |
| Visual Display of Manual |  | 10 |

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